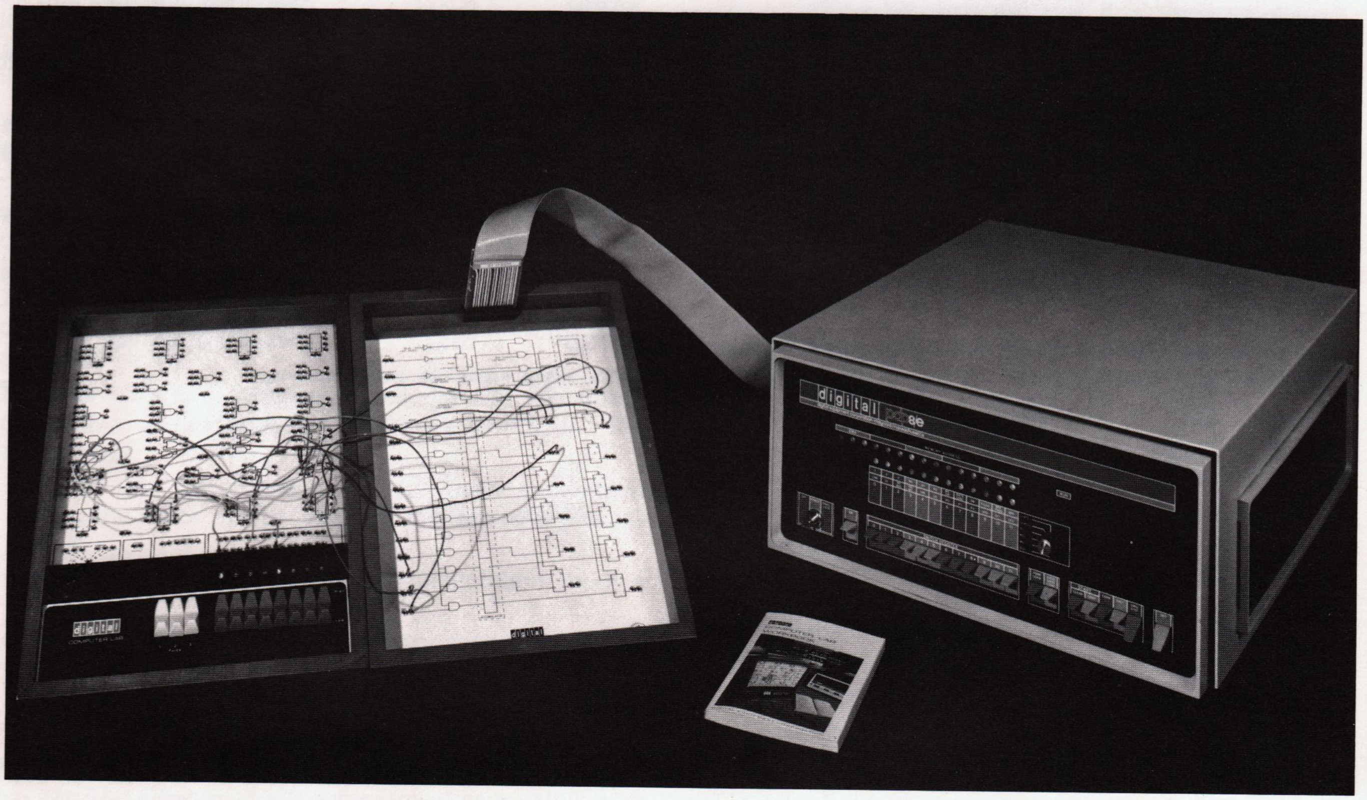
DIGITAL EQUIPMENT CORPORATION

education

"Hands On" Digital Logic and Computer Interfacing



Input/Output Access through the Accumulator under Program Control

Computer Interfacing via Patch Cords

- Simplifies the interfacing of external devices to a computer.
- Enhances the versatility of the PDP-8/E in experimental applications.
- Enhances the usefulness of the DIGITAL Computer Lab in training applications.
- Permits visual examination of input/output transfers as well as interprocessor communications.
- Makes the input/output bus of the PDP-8/E available on a patch panel complete with symbology.

COMPUTER INTERFACE PANEL H502

The Computer Interface Panel Model H502 is an accessory to the PDP-8/E computer which greatly simplifies the task of interfacing external devices such as the DIGITAL Computer Lab, by making the computer's entire input/output section available to the user on a patch panel, complete with the appropriate logic symbology.

A prerequisite to the H502 is the DB8-EB Interprocessor Buffer which contains all of the electronics which is illustrated by the logic symbols on the H502. All data transfers to and from the computer are under program control. All twelve bits of the accumulator are available on both input and output. Gates are provided on input and flip-flops on output.

digital

COMPUTER INTERFACE PANEL H502

Operation

The operation of the H502 interface panel is identical to that for the DB8-E since the former is in effect a patch panel termination of the latter. The following description of operation is taken from the DB8-EB specifications and refers to a mode of operation in which two PDP-8/E's are communicating with each other under program control. This is only one of the many uses for the H502 in the laboratory or classroom, but this application serves to describe the theory of operation in the fullest sense.

Referring to the DB8-EA block diagram, data is handled in the following manner for a transmit IOT:

a. First, the AC is loaded into the transmit buffer in 8/E #1. Immediately, the data becomes true at the inputs to the receivers in 8/E #2.

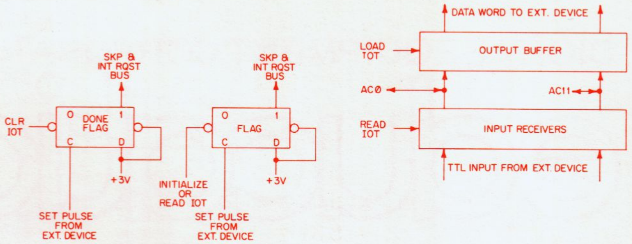
b. At TP3 of the IOT, the flag is set in 8/E #2, signifying to 8/E #2 that data is ready to be read, and if Interrupt Enable is true, Interrupt Request occurs.

For a receive IOT, the following takes place:

a. When the read IOT occurs, the receivers are enabled in 8/E #2 and the data is loaded into the AC on a jam transfer.

b. At TP3 of the IOT, the done flag in 8/E #1 is set to a one, indicating that the data has been serviced by 8/E #2.

The same sequence of events will occur when transferring data from 8/E #2 to 8/E #1.

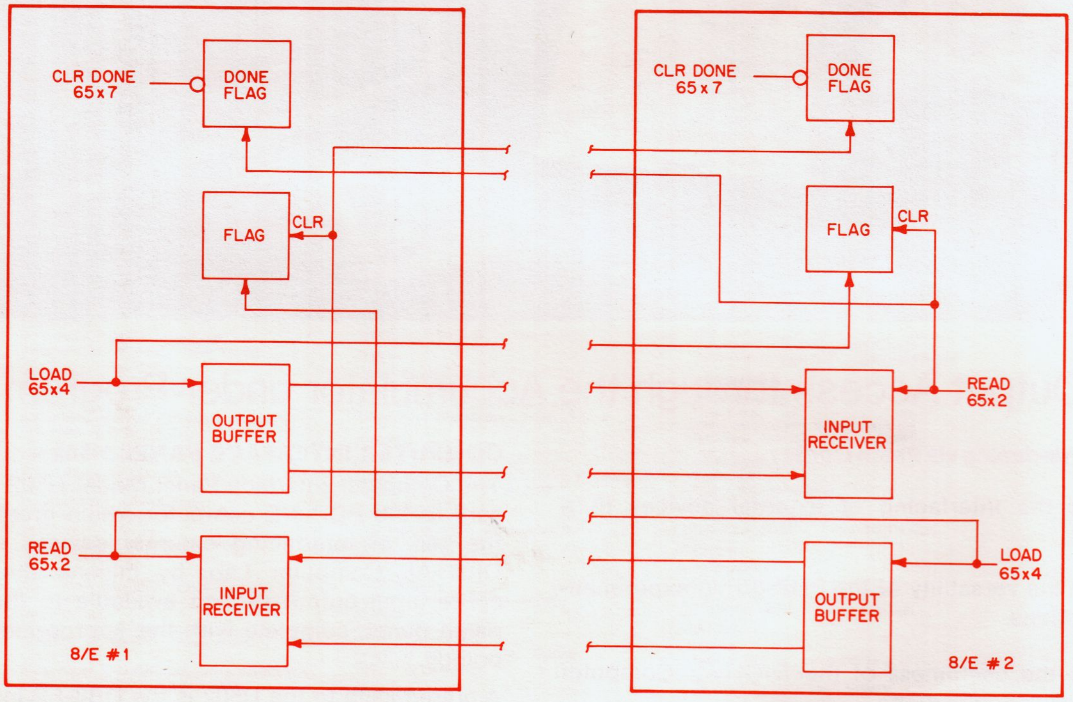


DB8-EB GENERAL PURPOSE INTERFACE DIAGRAM

Programming

Mnemonic	*Octal Code*	*Function*
DBRF	65x1	Skip if the receive flag is set to a 1.
DBRD	65x2	Read incoming data into the AC, clear receive flag.
DBTF	65x3	Skip if the done flag is set to a 1.
DBTD	65x4	Load the AC into the transmit buffer, transmit and set the transmit flag.
DBEI	65x5	Enable the Interrupt Request line.
DBDI	65x6	Disable the Interrupt Request Line.
DBCD	65x7	Clear the done flag.

NOTE: Initialize disables interrupts from occurring.



DB8-EA INTERPROCESSOR BUFFER DIAGRAM

Specification

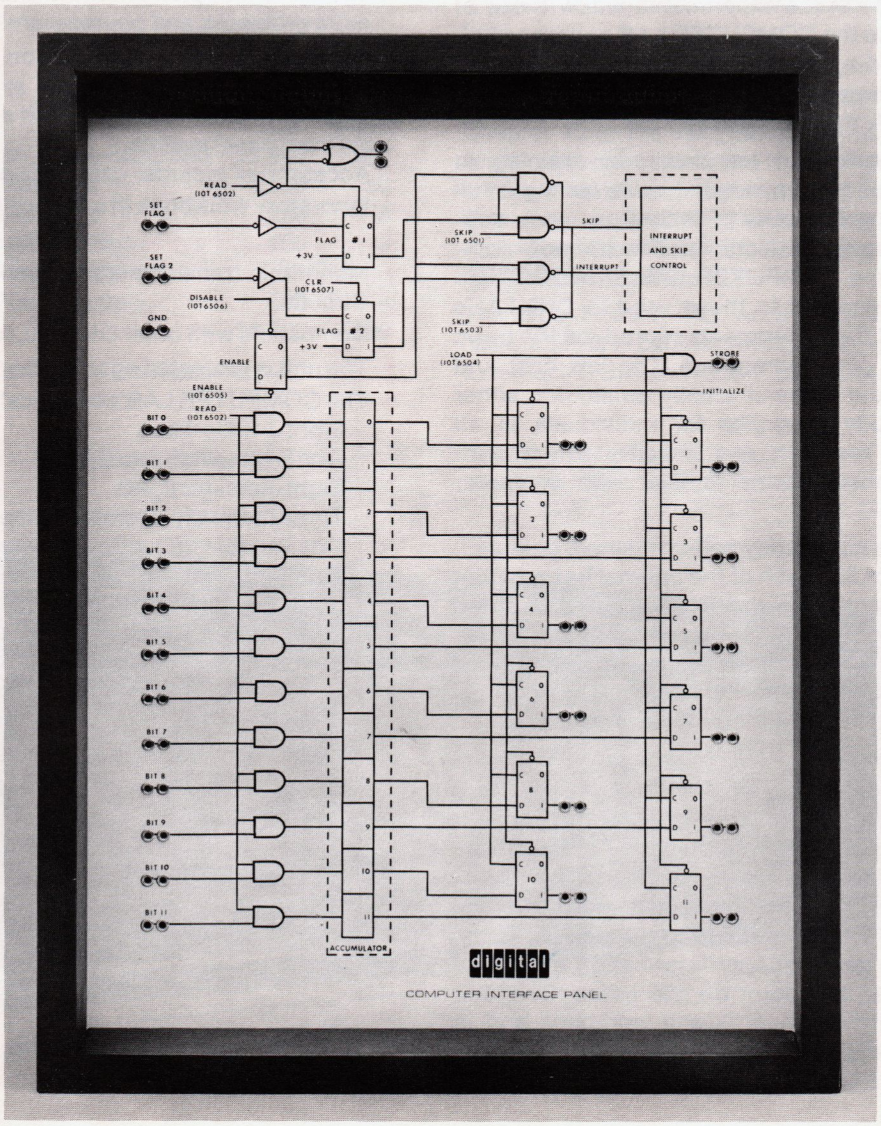
Device Codes:	The device codes on the DB8-EB are jumper selectable between 50 and 57. They are depicted as 50 on the Interface Panel, but where multiple panels and multiple DB8-EB's are used with one computer, the user must modify the codes and the symbology accordingly. This can be done by labelling the interface panels from 0 to 7.
Speed:	12 bits at 5 KHz.
Cables:	Two interconnecting cables are required to connect the H502 to the DB8-EB (a 10 ft. length of such cable is supplied with the DB8-EB).

The H502 Interface Panel will serve as a useful tool in research and teaching applications in which access to a computer's input/output electronics is essential whether it be for interfacing of an external device, illustrating of input/output transfers of data, teaching machine language programming, or transferring data between computers.

It is a useful accessory to the H500 DIGITAL Computer Lab since it allows complete interaction between a digital experiment on the computer lab and a program stored in the memory of the computer. It greatly simplifies the understanding of computer interfacing principles and conversely it greatly simplifies interfacing tasks for those who fully understand the principles involved, and would like to "patch up" an interface by sight.

Minimum Configuration

		Price	*Mo. Maint.*
PDP8/E-BA	Computer	$4,990	$50
LT33-DC	ASR33 Teletype	1,500	30
DB8-EB	Interprocessor Buffer	500	5
H502	Computer Interface Panel	100	—
	TOTAL	$7,090	$85



COMPUTER LAB H500

Computers are revolutionizing the modern world. Over 50% of today's high school students will eventually be exposed to computers. Most secondary schools have already begun instruction in binary logic theory. To provide educators with a dynamic and powerful teaching aid for demonstrating the "new math", Digital Equipment Corporation has developed the COMPUTER LAB, a complete classroom laboratory for teaching digital logic and computer fundamentals.

DIGITAL has over 15,000 of its PDP computers installed in all areas of science and industry and is the largest supplier of small on-line real-time computers for education. The COMPUTER LAB incorporates the latest advances in computer technology—another advance by the leader of computer innovations in education.

The COMPUTER LAB Workbook gives the student step-by-step instructions in digital logic principles. He can follow each step of the instructions by wiring the unit with easily inserted and removed patchcords and then test his final design. The course provides a set of ten experiments illustrating the full range of digital logic principles.

The COMPUTER LAB course can be tailored to different educational levels—from high school "new math" courses to university level electrical engineering programs. The format and sequence of the experiments follow those of leading textbooks, so the COMPUTER LAB course can be easily supplemented by a reading program. Since each experiment is as independent as possible of all others, an instructor can modify the course sequence.

As a laboratory instrument for classroom training in digital logic, the unit can provide a course lasting a full semester, comprising 50 hours of laboratory work supplemented by 30 hours of lectures. For training computer technicians, the COMPUTER LAB furnishes logic functions that are identical to those used in DIGITAL's PDP computers and the experiments reproduce the basic internal operations of all computers. The low cost and portability of the unit make it ideally suited for either home or office study programs for individuals in all areas of business, research and industry where non-technical people must become familiar with computer fundamentals.

The attractive unit is completely self-contained, compact, portable and easy to use. Each of the internal basic digital functions is represented on the front panel by a logic symbol in standard, widely accepted symbology. All connections for each experiment are made on the front panel with the patchcords and the student can progress from one experiment to the next quickly and easily.

Once the student has wired a logic design on the front panel, he can test it by supplying signals in either of two ways. A series of three manually operated pulser switches provides pulse signals to the logic. The unit also has an internal variable-frequency clock that can automatically supply test pulses at any point in the system. Eight rocker-type switches provide input signals to the logic and indicator lamps supply information about the state of the logic at any point on the board. The unit comes complete with patchcords and workbook and is ready for immediate use. The maximum voltage present on the COMPUTER LAB front panel is +3 volts.

Features

- Teaches modern computer logic
- Comprehensive Workbook includes basic text material and ten detailed experiments
- Provides up to 50 hours of laboratory study
- The ten basic experiments can be divided into more than 30 sub-experiments
- Teacher's Supplement with answers, additional text, extra problems, and course plans
- Easy to use: each logic function is represented on the front panel by MIL STD-806 symbology. Inputs and outputs of each internal circuit are accessible through the front panel eyelets
- Accessories include: carrying case, deluxe patchcord, laboratory workbook in a 3-ring binder

Electrical Specifications

- Monolithic transistor-transistor logic (TTL) Integrated Circuits
- Compatible with other DIGITAL logic devices
- The unit is protected against short circuits
- The COMPUTER LAB's electrical circuitry includes:
  - Eight J-K flip-flops
  - One 8-bit switch register
  - Eight indicator lights
  - Three manually operated pulser switches
  - One variable frequency clock
  - Four 4-input NAND Gates
  - Six 3-input NAND Gates
  - Eight 2-input NAND Gates
  - Four AND/NOR Gates
- Variable frequency clock provides 1 pulse per second to 10 MHz
- Built-in power supply uses standard house voltage 105–120, at 50 or 60 cycles, provides +5V to the logic

Mechanical Specifications

- Rugged and portable with attractive simulated teak frame
- Compact, convenient size (12½" wide x 17" long x 3¼" deep)

Price

H500 Computer Lab, including Workbook	$375
In quantities of two or more	350

Interfacing Directly to the Input/Output and Data Break Bus

I/O ACCESS PANEL H309-C

The type H309-C I/O Access Panel allows for direct access to the input/output bus lines of the PDP-8/E computer. It is designed for researchers, students, and engineers who design and interface logic devices and peripherals. The I/O Access Panel makes the entire input/output bus and external sense lines immediately available on the front of a PDP-8/E system cabinet via five connector blocks.

A standard feature is a regulated +5 volt power supply which delivers sufficient current to drive approximately 50 to 100 standard integrated circuits. Over-current and over-voltage protection are provided. When maximum limits are exceeded, power supply shutdown occurs, the voltage level drops to zero and an overload condition indicator is displayed. The regulator circuit can be reset by operating the power supply on/off/reset switch.

Power supply characteristics:

DC Voltage:	+5 volts
Maximum Current:	5 amperes
Shutdown Time:*	10 msec (approx.)

*Occurs when maximum electrical limits are exceeded.

Minimum Configuration *

		Price	Mo. Maint.
PDP8/E-CA	Computer, Rack-Mounted	$5,640	$50
LT33-DC	ASR33 Teletype	1,500	30
KA8-E	External I/O Bus	250	3
KD8-E	Data Break Interface	500	3
H309-C	I/O Access Panel with H710 Power Supply	630	4
	TOTAL	$8,520	$90

*Plus cables, connector blocks, and student kits as desired (See last page).

Interface Connections

All interface connections to the PDP-8/E can be made at the assigned connector(s) on the I/O Access Panel.

The connectors and assigned use for interface signal connections are:

RECEPTACLE	USE
BAC	ACCUMULATOR OUTPUT, IOP TIMING
BMB	MEMORY BUFFER OUTPUTS
AC IN	ACCUMULATOR INPUTS, SKIP, INTERRUPT REQUEST
DATA ADD	DATA BREAK ADDRESS INPUTS
DATA	DATA BREAK DATA

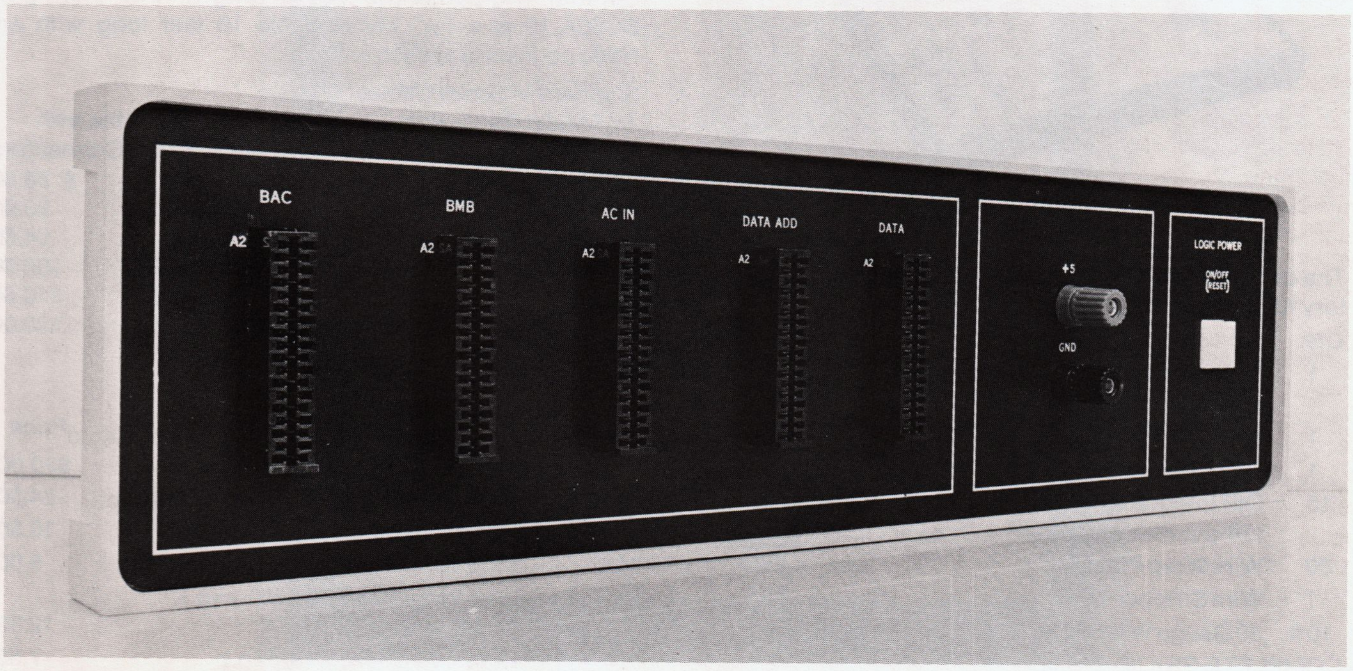
Terminals A1, C1, F1, K1, R1, T1, C2, F2, J2, L2, N2, R2, and U2 of these receptacles are grounded within the computer. Terminals B1, D1, E1, H1, J1, L1, M1, P1, S1, D2, E2, H2, K2, M2, P2, S2, T2, and V2 carry signals. Terminals A2 and B2 are not used. The terminals mate with either M903 or M904 Cable Connectors.

All logic signals passing between the PDP-8/E and output equipment are positive voltage levels, allowing direct TTL logic interface with appropriate diode clamp protection.

Positive level for a low logic state is 0 to 0.4 volts. Positive level for a high logic state is +2.4 to +3.6 volts.

Chapter 10 of the 1972 Small Computer Handbook presents cable connections to the PDP-8/E I/O Bus. A signal is true when its polarity matches the suffix character of its name; i.e., BAC 00 (1) H will be high when AC00 (1). A program interrupt will be requested when the line INT RQST BUS L is pulled low.

The type H309-C I/O Access Panel mounts within a basic PDP-8/E cabinet and connects to the type KA8-E External I/O Bus and KD8-E Data Break Interface.



LOGIC DESIGN LAB KIT H311

Type H311 Logic Design Laboratory Kit is used by engineers, students, researchers, and technicians for the fabrication of special logic devices and computer interfaces. It is a complete set of working implements for the building of specialized PDP-compatible logic modules.

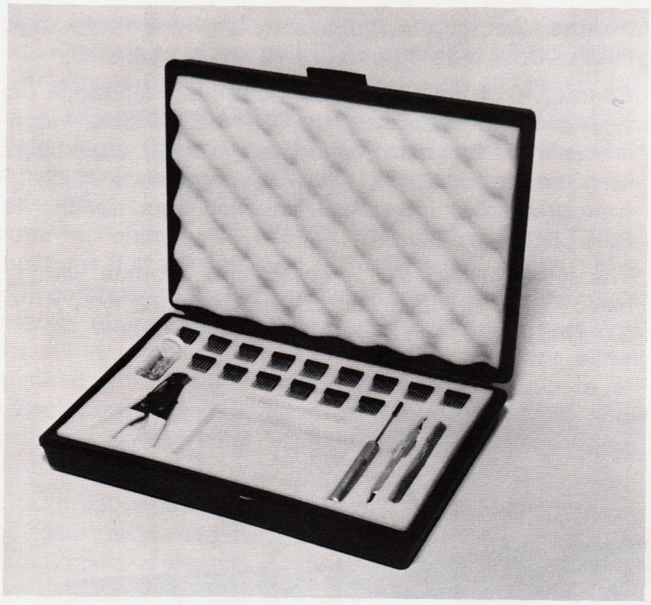
Included are all components that are required for the construction of a logic board utilizing integrated circuit sockets and wire wrap technique. All parts are reusable and are foam packaged in a strong, plastic carrying case.

The W979 is a double-sided, double-height collage mounting board that will accommodate 14 and 16-pin dual inline IC's with or without 16-pin wire wrap sockets and/or solder sockets.

Among the unique uses of the collage board is that it allows construction of prototypes, or the production of limited runs. An advantage of its use in system configuration is that it permits logic functions from a group of modules to be collected on it.

Up to 18 IC's can be mounted on the W979 board. The user has the option of using straight IC's, wire wrap sockets, solder sockets, or any combination of these.

There are 72 pin slots, of which four are ground, two are used for power, and the remaining 66 slots are available for input and output logic functions.



The complete contents of the H311 Logic Design Laboratory Kit are as follows:

Qty.	*Description*	*Part No.*
1	Collage Mounting Board (holds up to 18 integrated circuit sockets).	W979
1	Wire Wrap Tool (30 gauge)	H811A
1	Unwrapping Tool (30 gauge)	H812A
15	DIP Integrated Circuit Sockets (16-pin wire wrap type)	#953
80	Wire Wrap Pins	#952
1	Wire Stripper Tool	N/A
10 ft.	30 Gauge Wire	N/A

COMPLETE PRICE: $85.00

MODULE TEST ASSEMBLY H310

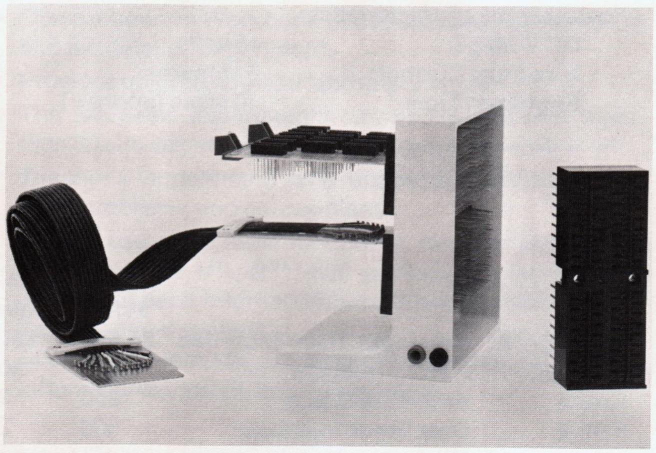
The H310 Module Test Assembly provides a convenient bench mount for connecting DEC-compatible logic modules to a PDP computer for run-time mode testing and troubleshooting.

The Assembly includes two standard H803 connector blocks capable of handling up to eight standard M-series cables plus four double-height modules (or two wire wrapped W979 or W969 collage mounting boards).

The Test Assembly is designed for two stable bench positions, a normal position for probing the module and an upright position for probing the cable signals leading to the computer. Two power jacks are premounted.

A rubberized pad provides a non-slip surface for the upright position. The frame is cast aluminum. The cables and mounting board shown are optional and should be ordered separately.

PRICE: $50.00



PREASSEMBLED CABLES

Standard preassembled cables are available in lengths of 3, 5, 7, 10, 15 or 25 feet. The last figure in the part number indicates the cable length. For example, BC08A-10 is a 1¼″ Mylar Cable 10 feet long with an M903 connector at each end.

Standard M Series Cables

1¼″ Mylar Cable with M903-M903 Connectors		Flat Coax Cable with M904-M904 Connectors	
BC08A-3	$40.50	BC08B-3	$ 86.00
BC08A-5	43.50	BC08B-5	90.00
BC08A-7	46.50	BC08B-7	94.00
BC08A-10	51.00	BC08B-10	100.00
BC08A-15	58.50	BC08B-15	110.00
BC08A-25	73.50	BC08B-25	130.00

REPLACEMENT PARTS

Part No.	*Description*	*Price*
W979	Collage Mounting Board	$20.00
H811A	Hand Wire Wrapping Tool (30 ga.)	24.50
H812A	Hand Unwrapping Tool (30 ga.)	10.50
952	Wire Wrap Pins (40/pkg.), 30 ga.	6.00
953	Wire Wrap IC Socket (10/pkg.), 30 ga.	12.50
954	Solder IC Socket (10/pkg.)	7.50

TEXTBOOK: EXPERIMENTS IN DIGITAL LOGIC AND COMPUTER INTERFACING

The Authors:
Dr. D. S. Harmer, Dr. W. W. Graham, Mr. J. C. Alderman:
Georgia Institute of Technology, Atlanta, Georgia

New Technology Curriculum

A new course in practical computer technology and small computer application for engineering students has been prepared at the Georgia Institute of Technology in cooperation with Digital Equipment Corporation. This new curriculum provides all types of engineering and technical students with an appreciation and understanding of the use of small computers in data acquisition, monitoring, and control applications. Topics of study include digital logic (gates, flip-flops, scaling, etc.), hybrid logic (Schmitt triggers, ADC's and DAC's), computer organization and operation, and the elements of control systems. The course emphasizes techniques for integrating small computers into total industrial and scientific systems. These points are doubly re-enforced in the extensive laboratory portion of the course.

Practical Laboratory Approach

The laboratory work covers practical problems in computer interfacing and control. Each student designs and builds a succession of computer interfaces using state-of-the-art, integrated circuit technology. A PDP-8 or PDP-12 computer is used to run and test each circuit. This "hands-on" approach has the advantage of acquainting the student through experience with computer operations.

With the tools and supplies as described in this document, and an extensively illustrated workbook, the student will:

- Design and layout the circuit for each experiment using the mock ups provided in the laboratory workbook.
- Wire the circuits using the documentation he has prepared.
- Design and code a program to test the circuits.
- Test the circuits using the computer and his program.

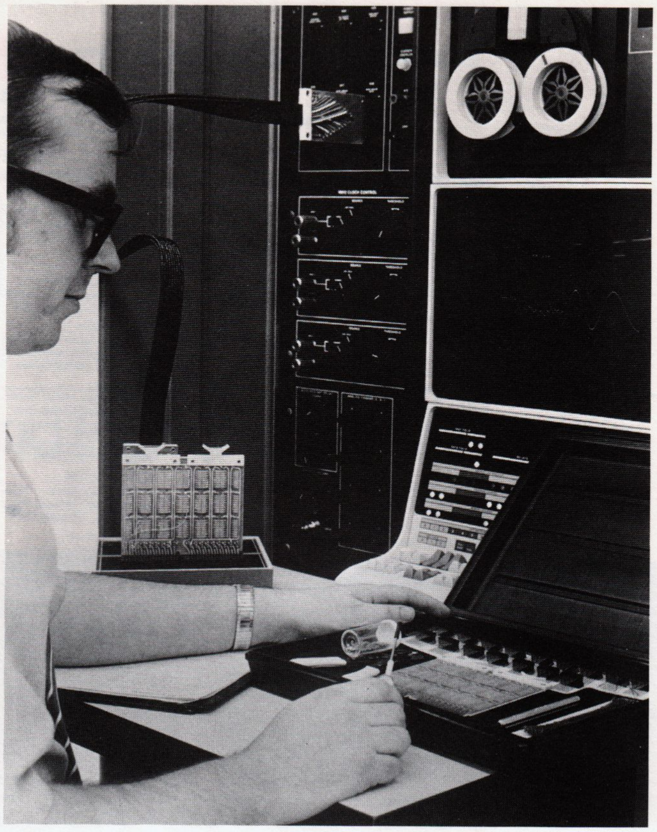
BASIC

All the PDP-8/E systems described in this brochure also run the BASIC language. It can be used as a calculator, for example:

PRINT SQR (77)	what you type
8.774964	what BASIC responds

In addition, BASIC can be used to write stored programs. Programs are natural sequences of English words and decimal numbers. The BASIC language is richly supported by textbooks and teacher aids. Students work directly at the machine, getting valuable "hands-on" computer experience. Programs may be run as soon as they are entered. Errors are detected and reported immediately. Corrections may be typed in without having to reenter the entire program. Completed programs may be punched on paper tape for quick reloading at a later date.

The BASIC Language Processor includes the following language elements: LET, PRINT, READ, DATA, GOTO, IF, FOR, NEXT, GOSUB, RETURN, INPUT, REM, RESTORE, DEF, DIM, STOP, END, LIST, RUN, SCRATCH, and nine standard functions.



Digital Logic and Computer Interfacing Curriculum Package for PDP-8/E Computer

Qty.	*Description*	*Price Each*	*Kit Price*
1	H309-C I/O Access Panel with H710 Power Supply	$630.	$ 630
3	H310 Connector Block Test Assemblies	50.	150
3	BC08A-3 M-Series Mylar Cable with M903-to-M903 connectors	40.50	122
10	H311 Logic Design Laboratory Kit with: 1—W979 Collage Mounting Board 1—H811A Wire Wrap Tool 1—H812A Unwrapping Tool 15—#953 DIP IC Sockets 80—#952 Wire Wrap Pins 1 Wire Stripper Tool 10 ft. 30 Gauge Wire	85.	850
10	Textbooks "Experiments in Digital Logic and Computer Interfacing"	3.	30
1	#935 1,000 ft. 30 Gauge Wire	60.	60
1	H314-B Integrated Circuit Sampler with 180 fully tested DIP Integrated Circuits 60 Four 2-Input NAND Gates 40 Two 4-Input NAND Gates 20 Two D Flip-Flops 20 4-Bit Binary Counter 10 8-Input NAND Gates 30 Four 2-Input NAND Gates (Open Collector)	230.	230
	TOTAL		$2,072

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	PDP8/E-CA	Computer, 4K Core Memory and Teletype Control. (Rack Mounted, slides and H960B cabinet included.) Unit consists of: 1 KK8-E Central Processor 1 MM8-E 4K Core Memory 1 KC8-EA Programmer's Console 1 KL8-E Console Teletype Control 1 Combination Power Supply, Chassis and OMNIBUS with 20 Quad Bus Slots	None	5,640	50	
	MC8-E	4K core memory, memory extension control and time share option. The MC8-E is required when expanding from 4K to 8K.	PDP8/E	2,750	20	
	MM8-E	4K Core memory	MC8-E	2,500	20	
	KA8-E	External Interface for Positive I/O Devices. (Three BC08J cables included.)	PDP8/E	250	3	
	KD8-E	Data Break Interface (Two BC08J cables included.)	PDP8/E	500	3	
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	LT33-DC	ASR 33 Synchronous Read and Punch Friction Feed	KL8-E	1,500	30	
	H309-C	I/O Access Panel with H710 Power Supply	PDP8/E	630	4	
	H310	Connector Block Test Assembly	H309-C	50	—	
	H311	Logic Design Laboratory Kit	None	85	—	
	H314-B	Integrated Circuit Sampler Kit	None	230	—	
	BC08A-3	M-Series Mylar Cable with M903-M903 connectors	None	41	—	
	#935	1000 ft. 30 Gauge Wire	None	60	—	
	—	Textbook "Experiments in Digital Logic and Computer Interfacing"	None	3	—	
	H500	ComputerLab	None	375	—	
	H502	Computer Interface Panel	DB8-EB	100	—	
	EDU8-B10	BASIC Compiler for 4K PDP8/E	PDP8/E	250	—	
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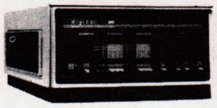

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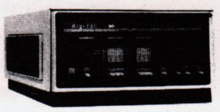

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